THE BROKEN HILL PROPRIETARY CO., LTD.
Iron and Steel Works,
NEWCASTLE.

ELECTRICAL HANDBOOK

. . FOR . .

NON-ELECTRICAL MEN

First Edition, January, 1926.
Second Edition, March, 1935.
Re-printed June, 1941.

Reg. C. Pogonoski Pty. Ltd., Printers, Newcastle

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FOREWORD.

This handbook is issued to indicate electrical hazards, and to try to prevent injuries arising from improper handling of electrical equipment and wires.

Electrical dangers differ from mechanical in that they are not self-evident. The Electrical Conductor looks the same whether alive or dead. For that reason electrical equipment and wires must always be assumed to be alive and therefore dangerous. Definite information that they are safe is necessary whenever contact with them is a possibility.

This handbook is to be issued to all men on these Works. It contains instructions to be followed by all.

THE MANAGER.

Note to Second Edition.

An asterisk is used to indicate new paragraphs and paragraphs materially changed.

REMEMBER THE DANGER TAG

Instructions to all Workmen regarding Electrical Equipment and Wires

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GENERAL :

In general, dealing with electrical equipment and wires is an electrician's job. Instructions to other workmen are confined to the precautions they must take when carrying out their work near electrical equipment or wires.

When your duties do not require you to approach or handle electrical equipment or lines, keep away from them.

EFFECT OF ELECTRIC SHOCK :

The effect of Electric Shock is well known. A man may be stunned or he may be killed. Electric shock does not usually kill at once. The victim may only be stunned for the time and animation only suspended. It is most important to try to restore breathing by artificial respiration as quickly as possible. The method is the same as that used in cases of drowning.

VOLTAGE :

Death is not entirely dependent on voltage. High voltages are undoubtedly more dangerous than low voltages. Cases of thorough contact with high voltages for an appreciable length of time have occurred which have not proved fatal. At the same time, contact with low voltages has killed. A fatality at 90 volts is on record.

The physical condition of the man shocked is a big factor. A man with a defective heart is very liable to serious effects.

DON'T FORGET THE DANGER TAG

Conditions as to dampness and moisture are a very big factor. Water is a good electrical conductor, and may induce good electrical contact.

In our works the 6,600 volts is more dangerous than the lower voltages; but the lower voltages are sufficiently dangerous to require care in handling such equipment and precautions in safeguarding it.

TREATMENT OF ELECTRIC SHOCK :

If a person is found in contact with live electrical equipment or wires the first thing to be done is to break the circuit.

It is most important to know the right way to do this. It is also most important to be familiar with the treatment of electric shock. Both of these matters are dealt with in our First Aid Handbook.

* EYE TROUBLE :

The rays from electric arcs which strike the eyes may seriously affect them.

Electric arcs may result from unexpected short circuits, or in such operations as electric welding or from moving contacts while electrical equipment is being operated, such as shoes on Crane Collectors.

After receiving a flash, the eyes may appear misty. If so, get attention at the Ambulance Station right away.

The full effect of a flash may not be felt for some hours. There may be no effect at all for some hours.

When the effect is at its height, the eyes may be extremely painful. Temporary blindness may result. These effects are, however, only temporary, the eyes reverting to normal after treatment and rest.

FIRST — THE DANGER TAG

If you think your eyes have been effected by a flash, even though pain has not yet set in, get treatment at the Ambulance Station.

After a flash, above all **rest the eyes** until next day. Don't read. Avoid bright lights, **particularly** the pictures.

If trouble develops after you are away from the works notify our Ambulance Station by telephone so that medical attention or advice may be given. In the meantime, keep light out of your eyes. **Wear a pair of dark goggles if they are available, or stay in a darkened room.** Put castor oil in the eyes. **Castor oil eases the pain.**

* REPORT SHOCKS.

If you receive a shock, even a slight one, report the occurrence immediately to the Electrician in your section or to the Electrical Shop.

FIRE NEAR ELECTRICAL MAINS OR EQUIPMENT :

If possible and practicable, switch off electrical equipment and deaden **mains if a fire occurs.**

LOCATION OF SWITCHES :

It is most **important for every man** to know the location of the **Switches of any machine he** may be working near, and also the Main Switches controlling the main source of electricity supply in any building he is working in.

* PROHIBITED AREAS.

Material or equipment is not to be stored near switches or control cubicles.

Switch cabinets, control cabinets, control cubicles and control rooms are prohibited areas for all persons other than electrical employees or employees duly authorised.

The use of such locations for storage of clothes, billies, or other material is prohibited.

LAST — THE DANGER TAG

USE OF FIRE EXTINGUISHERS :

There is danger in using fire extinguishing liquids in fighting fires near exposed live parts. The Electric Current may pass along the stream of liquid to the fire fighter, if the stream is continuous. A shock or worse may result. This applies particularly to waterhose. For use on Electrical Fires on ordinary electrical equipment, dry sand is the best medium if available; otherwise Pyrene may be used.

ELECTRICALLY DRIVEN MACHINERY :

A large part of the machinery on these Works is electrically driven. The care of the electrical machinery and equipment is the responsibility of the Electrical Department.

Men using motors and electrical equipment must confine themselves to operating Switches, Controllers and Starters. They must not interfere with Motors or with the starting gear itself, whether the Motor is stopped or running. If anything appears to be out of order the Departmental Electrician or the Electrical Shop must be called in.

The use of Switches, Controllers and Starters is simple and safe, but the following pointers are, however, given for your guidance.

Ordinarily, a man who has operated such equipment already is quite competent to show another. If, however, you think you need special instruction, or if you are in doubt about anything, or if you want to make sure that your methods are correct, ask your Foreman to show you, or to get the Electrician to show you. It's their job to show you.

AND ALL THE TIME — THE DANGER TAG

General.

There are two chief dangers to be guarded against, both of which can be minimised by correct operation. The hand may be burnt through an arc, or the eyes may be injured by looking at an arc.

When operating Switches, Controllers or Starters, if possible, use one hand only. Keep the other out of the way behind your back or in your pocket. If anything unexpected should happen, one hand only will then be effected.

The position of the hand is most important. Use the first finger and thumb to grip the end of the handle. Do not extend the forefinger or any other finger along the handle towards contacts.

Unless absolutely necessary, keep the eyes turned away when operating Switches, Controllers or Starters. If an unexpected flash occurs, your eyes will then not be affected.

When operating Switches, Controllers or Starters on wet ground, stand on a dry board.

When closing a Switch, do it smartly and put it right home.

When opening a Switch, do it smartly.

If you notice any covers off Starters, Controllers, Switches or Fuses, or if they appear damaged in any way, tell the Electrician, or report to the Electrical Shop.

* Protective Devices :

Electrical protective devices are provided on Cranes and other motor driven equipment. If you find that these devices have been damaged, interfered with or made inoperative, report to the Electrician or to the Electrical Shop.

WHY THE DANGER TAG ?

Starting Motors.

Before starting up any motor, make sure that no one is in a position to be hurt by the movement of the motor or the movement of the machinery driven by it.

The starting gear on Motors consists of two parts: the Main Switch and either a Controller or a Face Plate Starter.

Never close a Switch with the Controller or Starter ON.

Before closing the Main Switch prior to starting a Motor, the first thing to do is to see that the Controller or Starter is in the OFF position. If it isn't, move it to the OFF position. THIS IS THE MOST IMPORTANT RULE ON THE JOB.

With the Controller or Starter in the OFF position now close the Main Switch.

The next steps is to move the Starter or Controller DEFINITELY ON TO the first notch, and then continue moving the handle slowly to the full ON position.

A flash results when DEFINITE CONTACT is not made on the first notch. Flashes affect the eyes and should be avoided.

When using the square type Face Plate Starter with contacts on the front, if, for any reason, after first coming definitely to the first notch, it is not desired to bring the handle to the full ON position, open the Main Switch before releasing the starter handle. If not possible, pull your hand away quickly and allow the handle to drop of itself to the OFF position. The main point here is to pull the hand away quickly, to take it away from any arc which may result. If the handle sticks, open the Main Switch.

SEE LEAFLET No. 28 ON THE DANGER TAG

If Controller handle or Starter handle appears to be hard to move, tell the Electrician.

If the Motor does not start until the handle is moved more than usual, tell the Electrician.

Stopping Motors.

When stopping a Motor equipped with a Face Plate Starter, don't stop the Motor by knocking the Starter handle to the OFF position. Open the Main Switch instead. Then see that the Starter handle drops to the OFF position. If it does not, tell the Electrician before again using.

At all times, before leaving a Motor which is not to be left running, open the Main Switch, even if the Controller or Starter is in the OFF position.

* Inching :

Face Plate Starters are not designed for INCHING duty, and inching on such equipment is prohibited.

In locations where inching is at times necessary, special equipment is provided. Inching is not to be attempted without the special equipment.

* COLLECTORS :

On the inside of all runways for electric overhead cranes there are two conductors, supported on brackets. These conductors may be either wires, rails, angle irons or other structural shapes. Before any work is carried out adjacent to them, the main switch controlling the supply to them must be opened and danger-tagged.

Similar collectors are used for supplying current to some other types of moving machinery.

* ELECTRIC WELDING.

The use of electric welding in industry has considerably increased in recent years, and is still growing.

The use of this method has necessitated protection against damage to the eyes from arcs of the electric flashes.

All employees are warned not to watch welders and not to expose the eyes to rays from electric arcs.

Where electric welding is a regular practice, as in the Machine Shop and in the Fabricating Shop, special screened sections have been set apart for this work, and moveable screens have been provided.

Electric welders are instructed that screens are to be used, so far as practicable, when welding is being done away from the Welding Shops, in order to protect other employees against flashes.

DANGER TAGS :

Danger Tags are available by Foremen's requisition on the Store. These tags read :—

DANGER.

THIS SWITCH MUST NOT BE CLOSED.

This Tag must not be removed except by the undersigned or, in case of accident to him, by his Foreman.

Name ....
Dept. ....
Date ....

* Danger Tags as originally designed were printed in black on red cardboard. To make the Danger Tag even more conspicuous, a new design has been adopted. Instead of the All-Red Tag, the tag of the new design has a white cross on a red background.

Before starting work in any position, where putting power on a Motor, or starting electrically driven machinery may put you in danger, you must see that the MAIN

BIG — IN IMPORTANCE — THE DANGER TAG

SWITCH controlling the driving motor is open, and you must tie your signed danger tag on the handle of the switch. THIS RULE IS MOST IMPORTANT. The advantage of carrying it out is self-evident.

When a gang of men is at work in such a position, one tag for the whole gang may be used, to be put on by the Leading Hand or man in charge of the gang. Before taking the tag off, this man must assure himself that all members of the gang have left the job and are in positions of safety.

If you want to start work in such a position as described above and find the switch open and already tagged by some man not connected with you or your gang, put your own tag on in addition to the tag already there. There should be a tag for every individual man
* or gang on the job. The switch must not be closed until each danger tag has been removed by the person responsible for the tagging.

* The proper place to tie the Danger Tag is on the handle of the switch.

* Never close a switch without looking at the handle.

* In tying a Danger Tag, make dead sure that the tie is secure, and that the Danger Tag will not come off.

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* The ordinary Red (or Red and White) Danger Tag is used where it is dangerous to CLOSE a switch.

* In certain cases danger may result SHOULD A CLOSED SWITCH BE OPENED. For example, men using an extension light inside a boiler may be endangered should the light be switched off.

MOST IMPORTANT — THE DANGER TAG

* Blue Danger Tags, which read as follows, are available at the Store :—

DANGER
MEN AT WORK
WITH
EXTENSIONS
Pulling out this
Switch would put
us in darkness.
See me first.

Name..
Place at
Work..
Date..

* Danger Tags of this type are to be used on all appropriate occasions.

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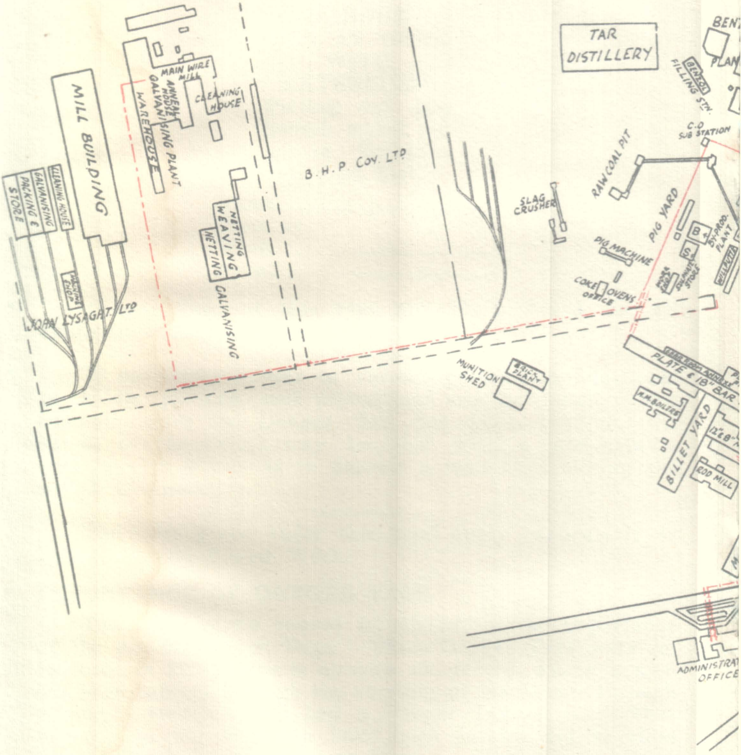
* **If conditions appear to warrant precautions additional to the Danger Tag, such precautions may be taken. For** example, after the Danger Tag has been put on, the handle of the switch may be tied with a non-metallic cord in such a way as to prevent a man from closing the switch unthinkingly.

The rules given under this head apply particularly to Inspection and **Repair Work.**

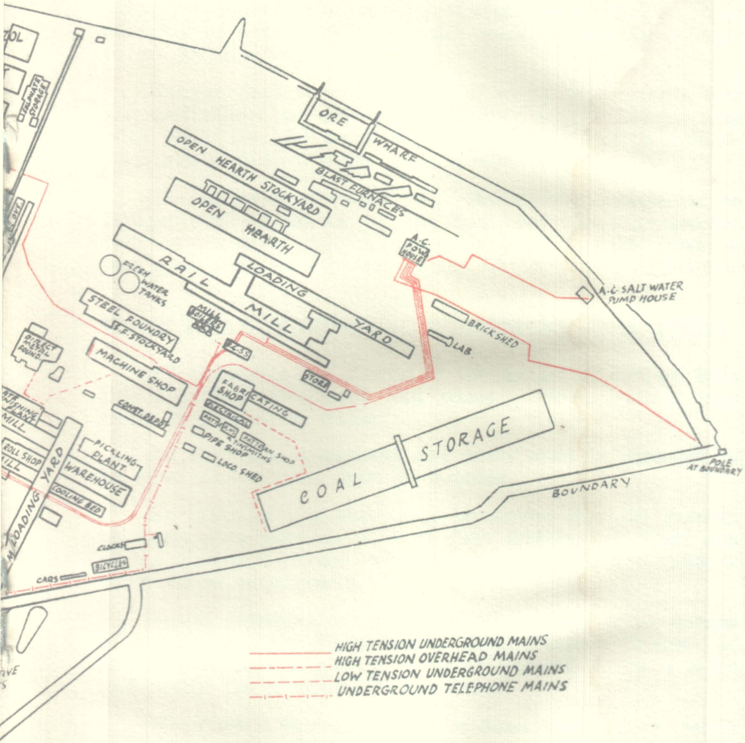
* IMPORTANCE OF DANGER TAGS.

Too much stress **cannot be placed on the importance** of the use of Danger **Tags. Since Danger Tags were introduced in 1924, there is no case on record where a man** has been injured through **the starting of machinery through** closing a switch which **had a Danger Tag on it. That means** that our workmen **have been careful not to close switches** with Danger Tags **on them.**

ALWAYS USE THE DANGER TAG



This diagram gives the position as at February, 1935. Exte
It is not practicable to keep the diagrams in all books up-to-date.
Electrical Department.



nsions and alterations to the cables are made from time to time. Up-to-date information must be sought, when necessary, from the

There have, however, been cases of serious injury through the premature starting of machinery which was out of order or under repair, through workmen having omitted to use Danger Tags.

Danger Tags should be part of every tradesman's tool kit, and should be used every time. Carry a Danger Tag with you. Go and fetch one if you have left it behind. That you were in a hurry is no excuse.

The importance which the Management attaches to Danger Tags is shown by the fact that the Management has, on occasion, felt it necessary to dispense with a man's services for a breach of the Danger Tag Regulations.

WORK NEAR ELECTRICAL EQUIPMENT AND WIRES:

All employees are warned of the danger of contact with live electrical equipment and wires. Such contact may result in a shock or worse.

All electrical equipment and wires must be assumed to be alive, and contact must be avoided.

No spike or peg must ever be driven into the ground, or excavation started, without first finding out from one of the electrical officers, whether or not an electric cable is likely to be encountered.

Unless damaged or interfered with, there is no danger of shock from the Underground High Tension Cables. If one of these Cables should be found exposed, leave it alone and notify the Electrical Department.

When work is required to be done which may result in contact with Electrical Equipment or Wires, the Chief Electrician or the Electrical Foreman must be notified. He

will arrange for the equipment or Wires to be made safe, or for the work to be done with the help of a competent Electrician. If the Chief Electrician or Electrical Foreman cannot be reached, the Electrical Engineer's office should be notified.

* In addition to the Day Staff, an Electrician is located in the Electrical Shop on the afternoon and night shifts. He can be reached in the Electrical Shop, Works telephone No. 51, or through the Works Telephone Exchange Operator.

HIDDEN WIRES :

If there is any doubt as to the route of cables or wiring, where work is being done, the Departmental Electrician or the Electrical Shop must be consulted. For example, cables feeding a motor may be hidden, and a thoughtless man may bore into them.

* SLINGING AND OTHER HAZARDS :

In many locations cables and wires are run in steel launders or pipes. These launders and pipes are in no circumstances to be used for attachment of slings or to take any weight, nor are the covers to be interfered with. The launders are not to be used as walkways.

Collector rails or brackets carrying collector rails or trolley wires are not to be used for attachment of slings or for taking weight.

POLES AND TOWERS.

Electrical Poles and Towers must not be used as anchors except by authority of the Electrical Engineer, Chief Electrician or Electrical Foreman. These poles carry electric power and lighting wires as well as telephone wires.

DON'T NEGLECT THE DANGER TAG

A pole may either be broken off or pulled from the ground under such treatment. If a pole were broken, the Mains might break and the loose ends become a hazard to anyone working near. In addition, an interruption in supply might take place, which might be a serious matter.

GUY WIRES AND ROPES :

Guy Wires and Ropes must not be fixed close to electrical mains. Some of these mains are uninsulated and, even if insulated, faults in the insulation may occur.

Apart from the possibility of accident during the fixing of the guys, failure of a guy might mean contact with the mains, with the possibility of accident and interruption of electricity supply.

PIPES AND STRUCTURES :

The running of pipes, alteration of existing structures, or erecting new structures near electrical mains or equipment must only be done after consultation with and in agreement with the Electrical Engineer, or his deputies by day or Shift Electrical Fitter by night.

* POWER HOUSES, MOTOR ROOMS AND SWITCH ROOMS :

All employees are forbidden to enter Power Houses, Sub-stations, Motor Rooms, Switch Rooms and Control Galleries, unless specially instructed to do so. Authorised persons only are allowed in these locations.

* EARTH WIRES :

An ''earth wire'' is a connection to ''earth'' from a motor frame, controller cover or a cover enclosing other electrical equipment. It is put there to ensure that, should a fault occur, the frame or cover does not become alive. It is a most effective safeguard against injury from electric shock.

DON'T OMIT THE DANGER TAG

Earth wires are readily recognisable. They consist of a piece of copper cable or copper strip, usually bare, fastened to the motor frame or cover. It may be necessary to carry an earth wire some distance to reach an effective earth. No copper wires, cables or strips are to be interfered with.

LAMPS :

Do not replace lamps or do anything to lamp sockets unless the controlling switch is open and the circuit dead.

* LIGHTS :

Lamps are provided throughout the works for general lighting. All general lights, except in certain locked-up shops, are to be on all night, every night in the year.

Special operating lights are also provided. These lights are to be in use during operating periods only.

FAILURE OF LIGHTS :

Should a failure of lights temporarily place any portion of the Plant in such darkness that you cannot see what you are doing, stop any travelling machinery and move cautiously.

In case of failure of lights, the getting of lights on again must be made an urgent job. If practicable and necessary, operations must be suspended until the lights are on again.

The work of getting lights on again is to be done by the Departmental Electrician or, if necessary, by notifying the Electrical Shop, Works Telephone No. 51.

EXTENSIONS :

Care must be taken in handling electrical extensions. Using damaged extensions is dangerous. Electric shocks or worse may result.

SAVES A LOT — THE DANGER TAG

Whenever

(1) The extension appears damaged outside, or

(2) The light goes out at intervals without apparent cause, or

(3) A shock is received during handling, even if the shock is slight, or

(4) The connections at either plug or lamp end appear loose.

the extension should be handed to the Departmental Storeman. The Departmental Storeman will then arrange for the extension to be overhauled or a new one issued.

If an extension is damaged during a job its use should be discontinued and another one obtained.

The current must always be switched off before inserting an extension into an ordinary lamp socket or batten holder.

* Extensions consisting of the usual workshop or ordinary cab-tyre flexible must not be used lying on the ground where the insulation may be subject to damage, e.g. in walkways or in barrow-ways.

* Often such extensions may be conveniently and safely carried overhead.

* If the overhead method is not practicable, and an extension must be used in a position where it may be subject to damage, the cable must be protected by rubber hose. Extensions so protected will be made up on receipt of an order by the Electrical Shop. Care must be taken in use to ensure that the fastenings of the hose at each end remain secure.

* NEON SIGNS.

Neon signs are installed at various locations. These signs are supplied with 250 volts A.C. This voltage is stepped up to 15,000 volts inside the case to which the sign is attached.

No employee, unless authorised by the Electrical Department, should touch one of these signs, damaged or otherwise. In case of damage, notify the Electrical Shop at once.

REPEATING MESSAGES:

To avoid misunderstandings and to prevent accidents, each person on receiving an unwritten message concerning the handling of lines and equipment, shall immediately repeat back to the sender and obtain his full name and acknowledgment. Each person sending an unwritten message shall require it to be repeated back to him by the receiver, and secure the latter's full name.

CURRENT DISTRIBUTED ON THESE WORKS:

Most of the current used on the works is generated here. The A.C. Power House is the main unit.

The current generated here is Alternating Current at 6,600 volts, 3 Phase. This current is transmitted to the Main D.C. Substation (the old D.C. Power House) and to the Coke Ovens Substation. At both these Substations the Alternating Current is converted into Direct Current at 250 Volts. At the Coke Ovens Substation it is also transformed into 440 volts 3 Phase A.C. and 250 volts single phase A.C. Direct current at 250 volts is distri-
* buted from the Plate and Bar Mill Engine Room and from the Skelp Mill Motor Room.

The great bulk of the electrically driven machinery on the Works is operated by 250 volts D.C. The great bulk of the lighting on the Works is also 250 volts D.C. The motive power at the Benzol Plant is 440 volts A.C., while the Benzol Plant lighting is 250 volts A.C. or D.C.

MAKE NO MISTAKE — THE DANGER TAG

Current at 6,600 volts A.C. is transmitted to the Sub-stations by underground cables. The routes of the cables are indicated on the diagram in the middle of the book. Damaging and thus forming contact with these cables is highly dangerous.

Current at 6,600 volts A.C. is also transmitted from the Coke Ovens Substation to Messrs. Rylands' Works by underground mains to the Southern end of the Pig Mill Gantry Crane runway, thence by overhead uninsulated wires. These wires are indicated by notices on the poles, and by the diagram in the middle of the book.

The 440 volts A.C. is distributed by overhead uninsulated wires. The 250 volts A.C. is distributed by overhead uninsulated wires. The 250 volts D.C. is distributed, sometimes by overhead uninsulated wires and sometimes through underground insulated cables.

* Current is also supplied by the Railway Commissioners. This is Alternating Current at 6,600 volts delivered to us by overhead wires to a pole at the Carrington boundary. From this pole the current is carried by underground cable at 6,600 volts to the outdoor switching station on the South side of the A.C. Power House. The only place at which this supply is exposed on the Works is at the Carrington boundary. This point is well protected by barbed wire and notices. The course of this underground cable is indicated on the diagram in the middle of the book. Damaging, and thus causing contact with this underground cable, is highly dangerous. The same is true of contact with the wires or switches on the pole at the boundary.

* Direct current at 54,000 volts is also transmitted from the Rectifying House near No. 3 Blast Furnace Stoves to the Cottrell Precipitator. This current is transmitted by a single wire run inside a protecting cage.

REMEMBER THE DANGER TAG

THIS HANDBOOK HAS BEEN ISSUED TO—

Name ....

Department ....

Date ....

Issued by ....

DON'T FORGET THE DANGER TAG

THE BROKEN HILL PROPRIETARY CO. LTD.,
(Iron and Steel Works)
NEWCASTLE

ELECTRICAL HANDBOOK

FOR

NON-ELECTRICAL MEN

Received one copy of above :

Name ....

Department ....

Date..

NOTE.—This receipt is to be filled in by the man to whom the handbook is issued and handed to the person issuing it. The slip is then to be sent to the Safety Superintendent.

Signature of person issuing :

A LITTLE THING — THE DANGER TAG